Update on SBS GEM prototypes tests at FNAL (Oct. 2013)

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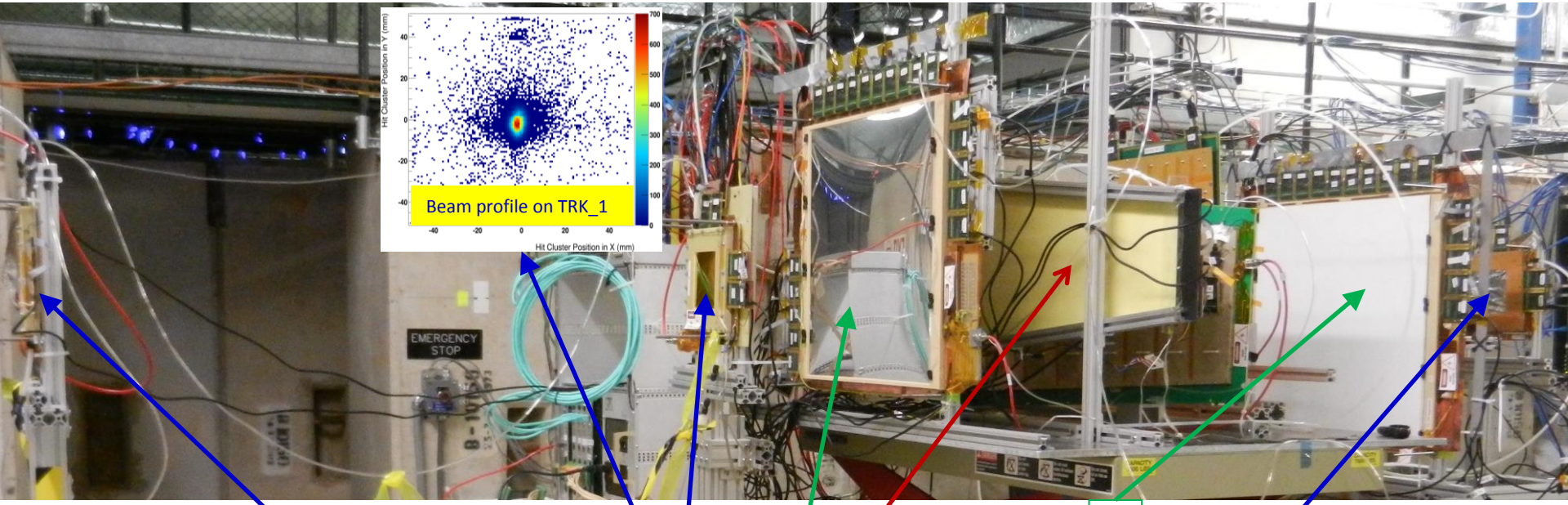
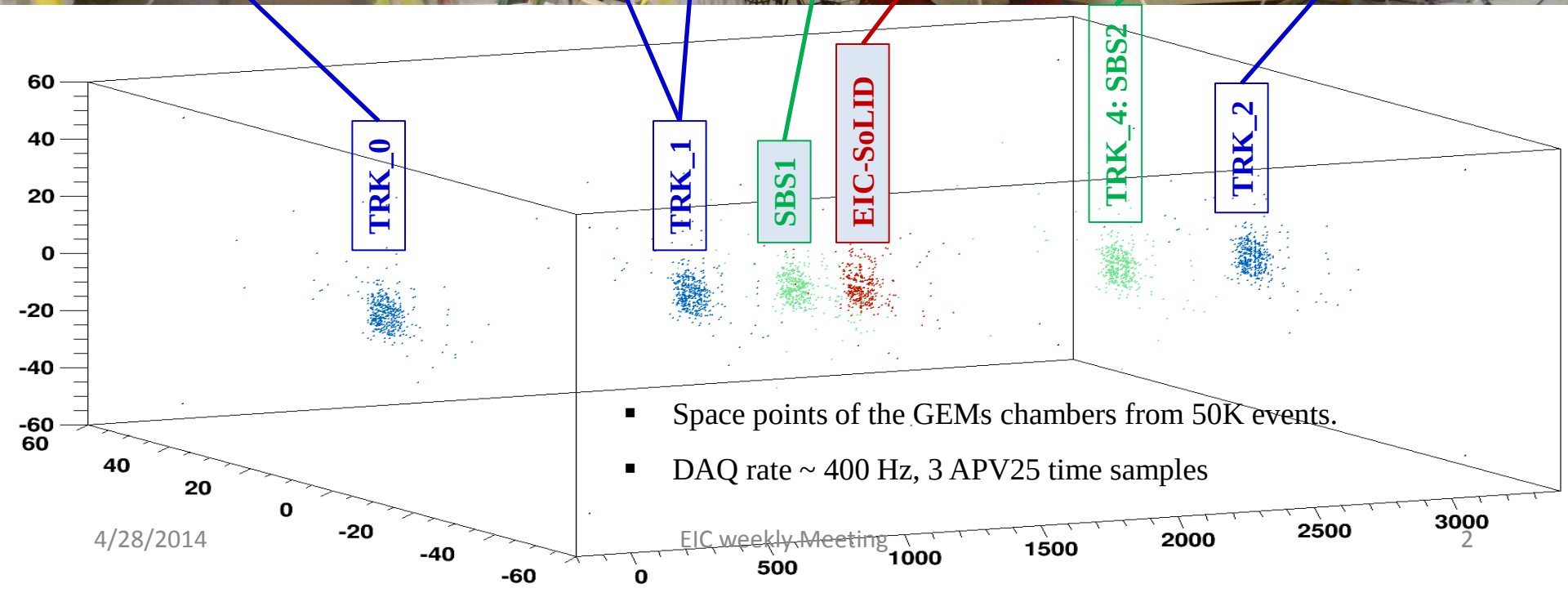
- Performances of the EIC prototype in the Test beam
  - Efficiency & resolution vs. beam position
  - Efficiency & resolution vs. HV
- Plans for the future

UVa GEMs @ FNAL Test Beam (Oct. 2013): 120 GeV Proton Beam

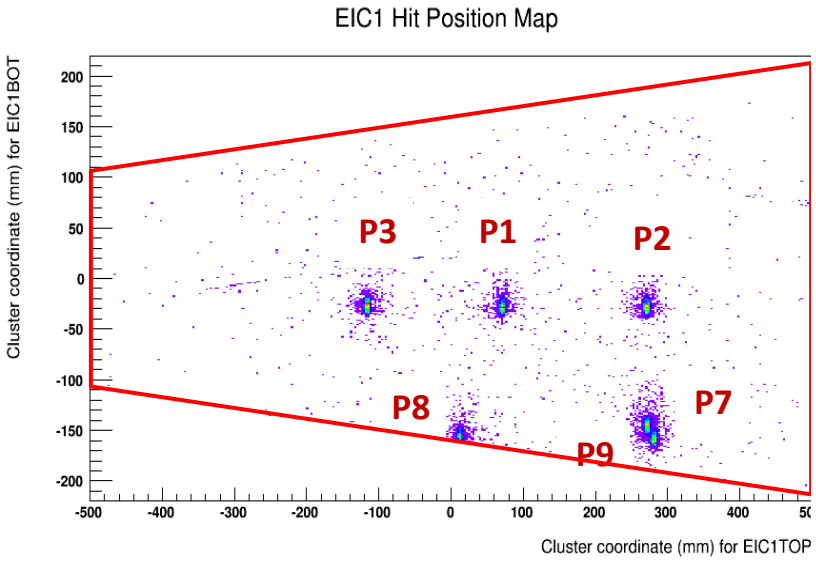




- Space points of the GEMs chambers from 50K events.
- DAQ rate ~ 400 Hz, 3 APV25 time samples

From Cartesian to cylindrical coordinates

- Tracking: Linear fit to get x and y coordinates from from the 3 small trackers
- φ and r coordinates and the residuals are calculated from the Cartesian coordinates as shown below
- Six Positions scanned on the EIC prototype with120 GeV Proton beam
- Zero suppression: 5 × σ cut pedestal noise for each channel.
- Clusterization: One or more hits per cluster



Cylindrical coordinates

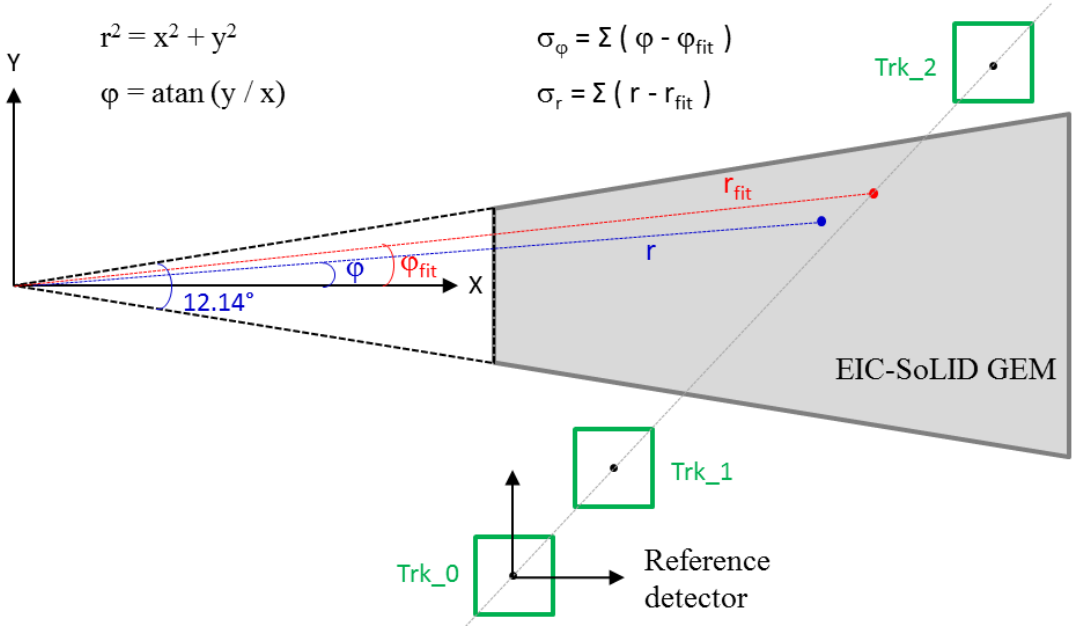
$r^2 = x^2 + y^2$

$\varphi = \mathrm{atan}\,(y / x)$

Residuals

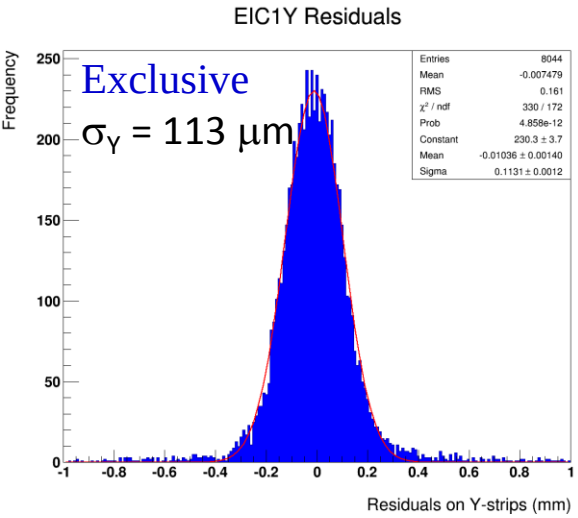
$\sigma_\varphi = \Sigma\,(\varphi - \varphi_{fit})$

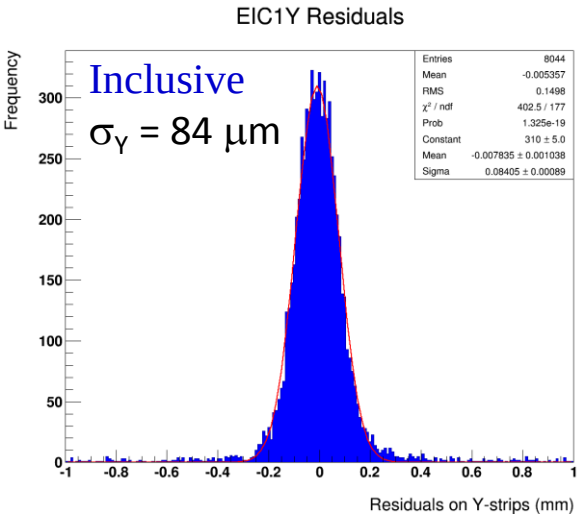
$\sigma_r = \Sigma\,(r - r_{fit})$

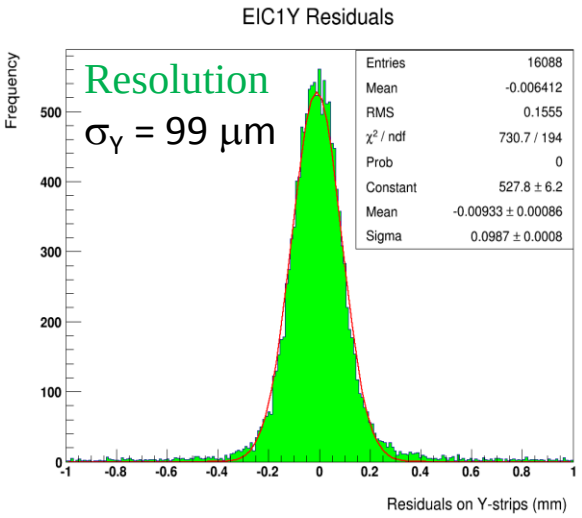


Resolution studies from track fit residuals

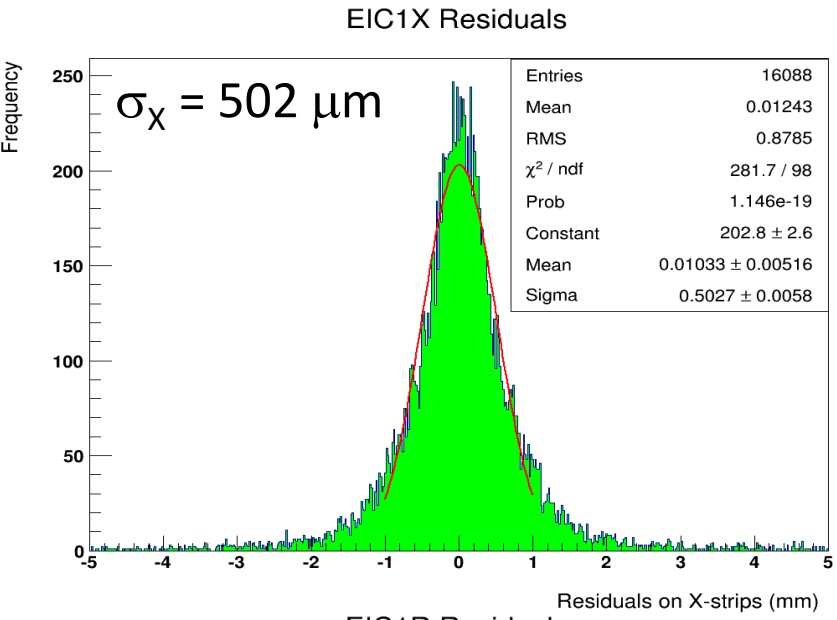
- Tracking: Linear fit in X and Y using the single event from the 3 small trackers
- Exclusive residual : EIC data point excluded from the track fit
- Inclusive residual : EIC data used for the track fitting
- Resolution: Width ($\sigma_{resolution}$) of the Gaussian fit to the combined exclusive and inclusive residual distribution: $\sigma_{resolution} = sqrt\ (\sigma_{exclusive} \times \sigma_{inclusive})$

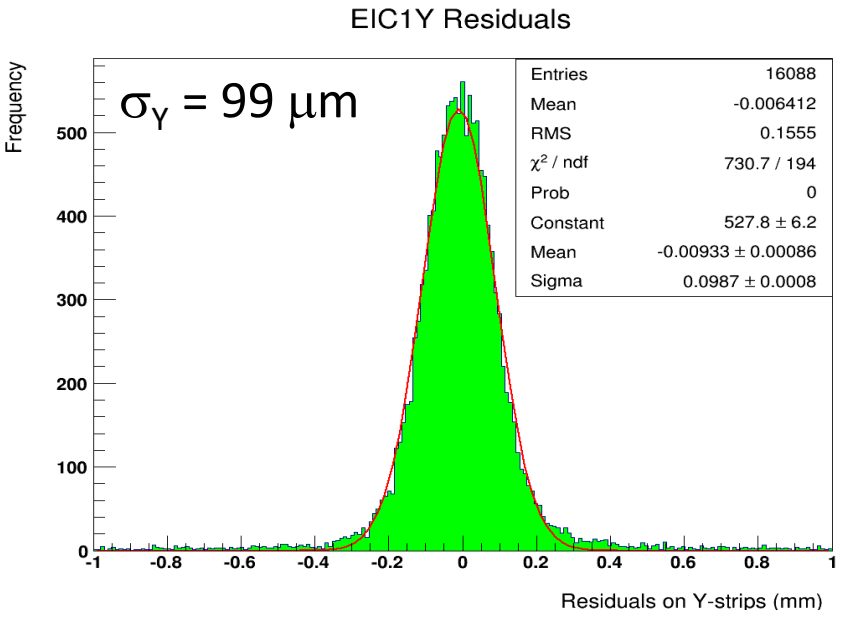


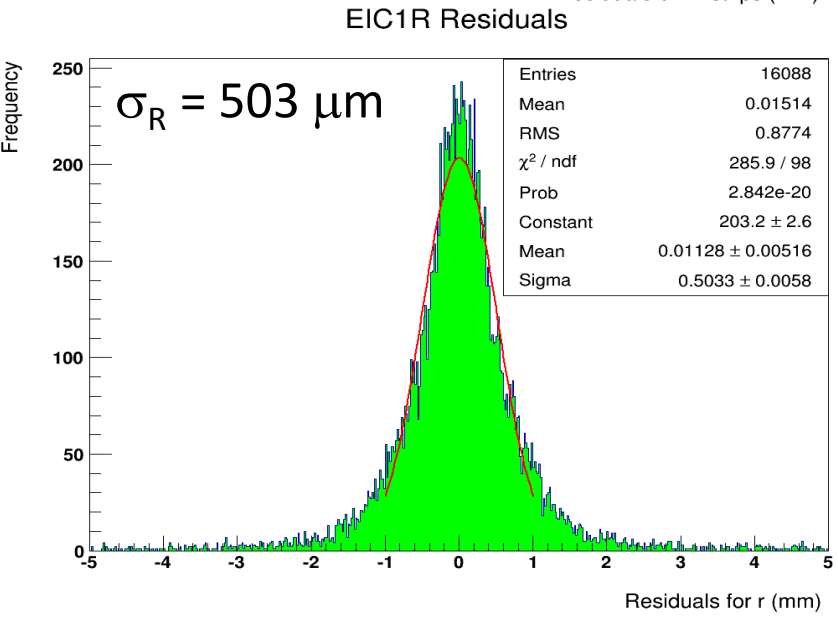


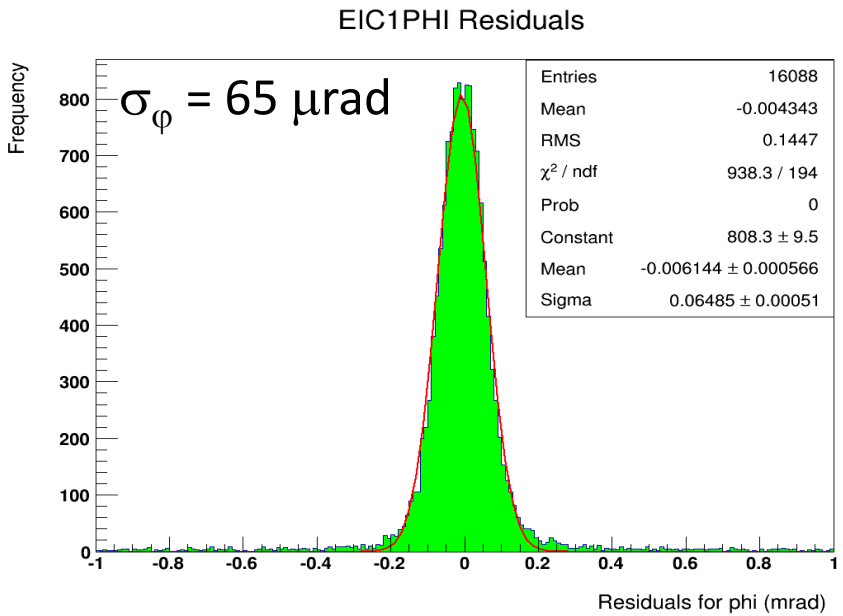


Resolution in x, y, r and φ @ P1

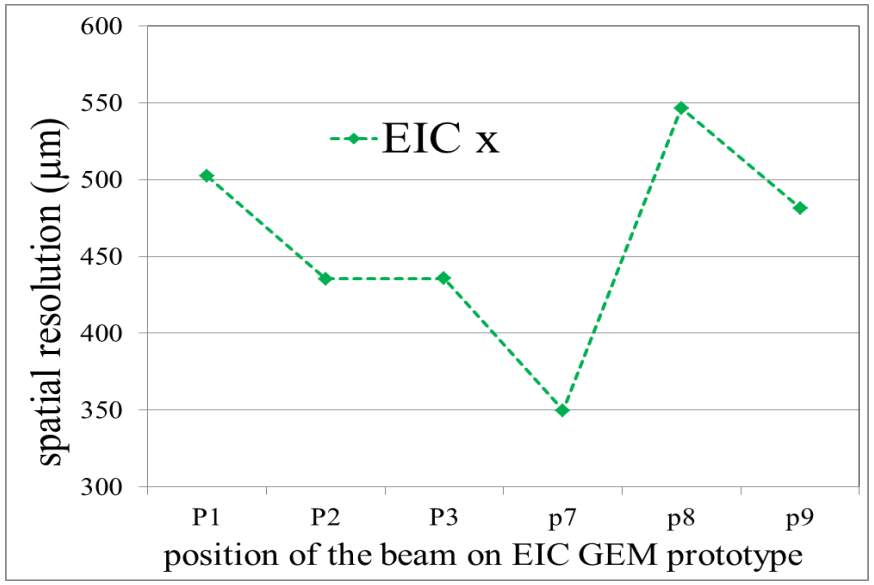


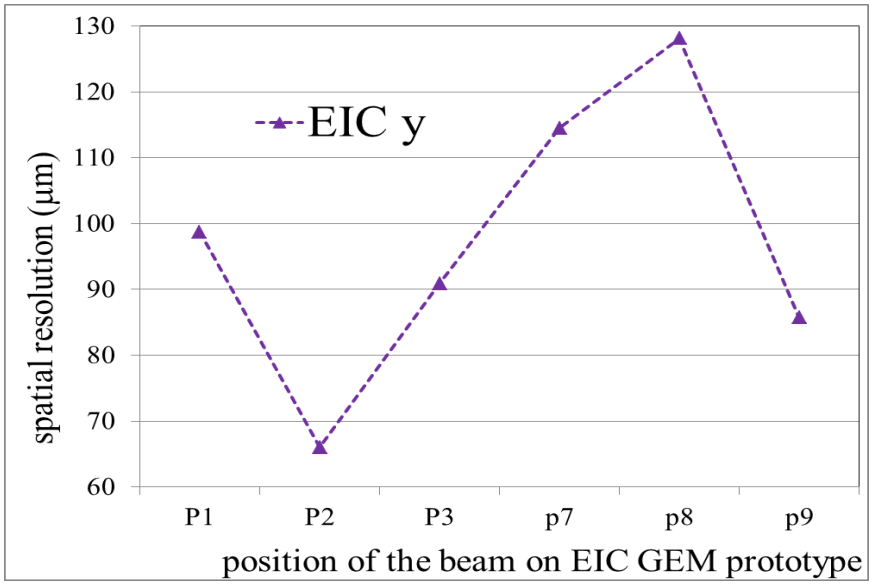


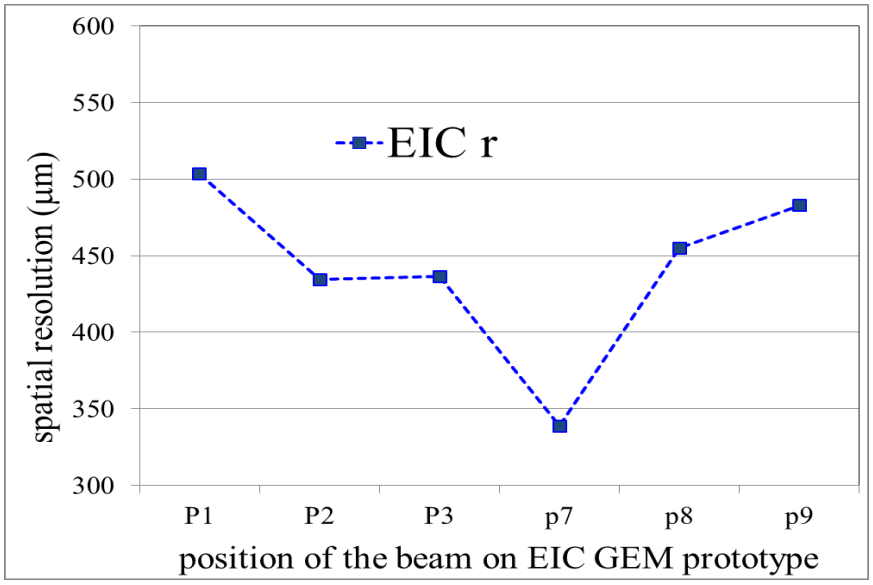


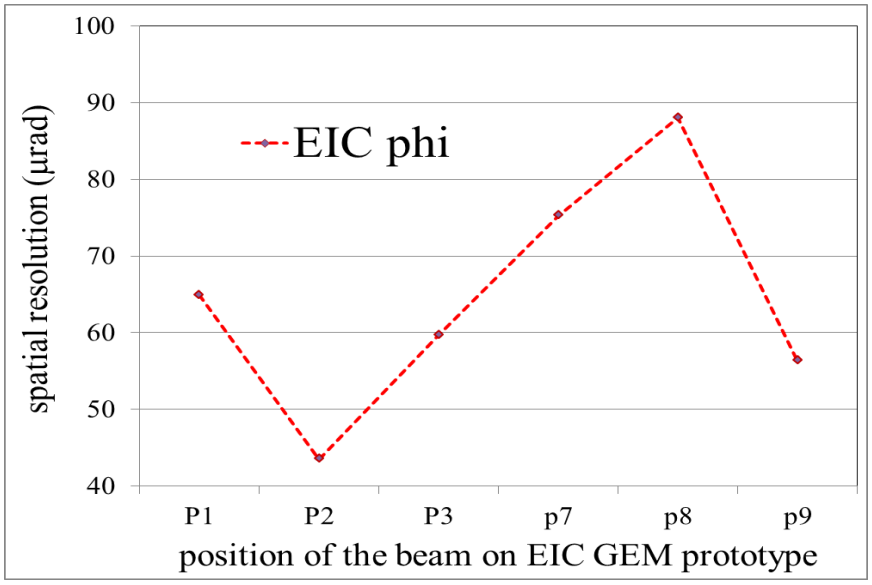


Resolution uniformity: Beam position scan

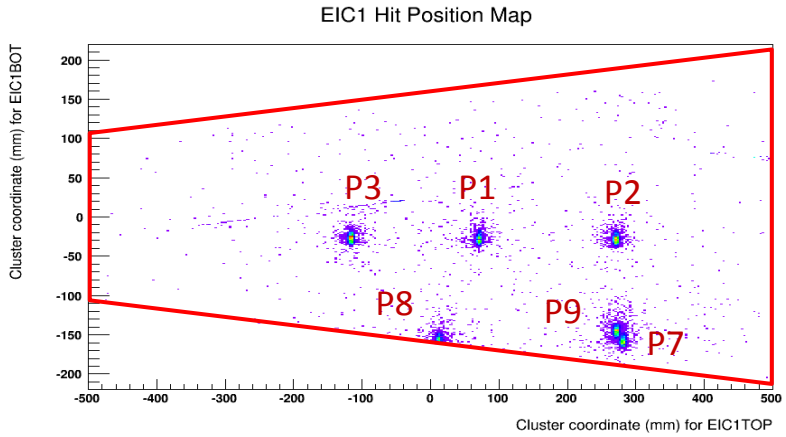




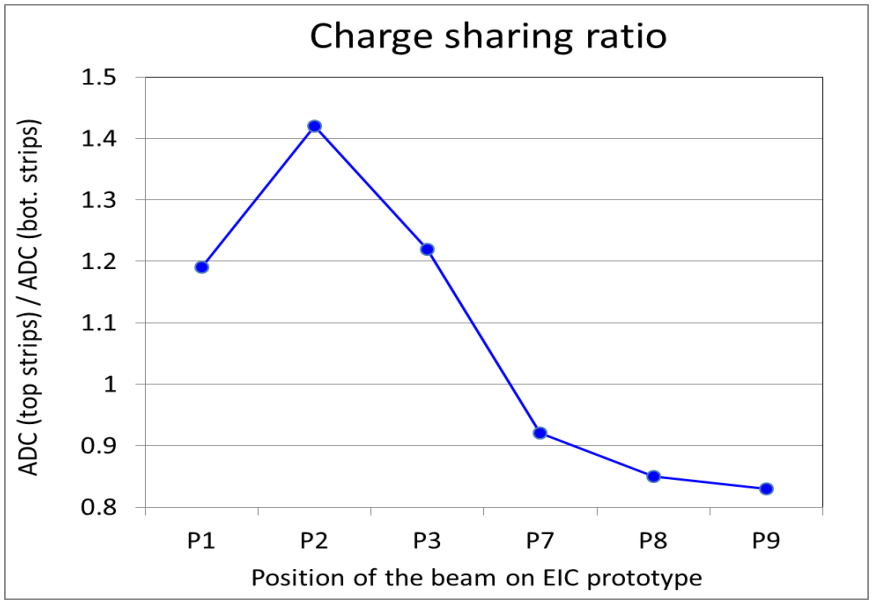


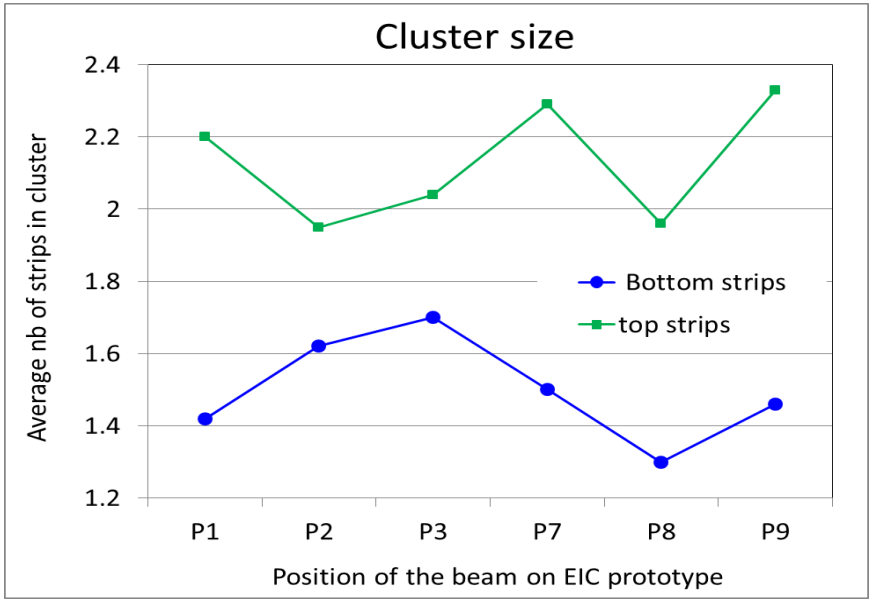


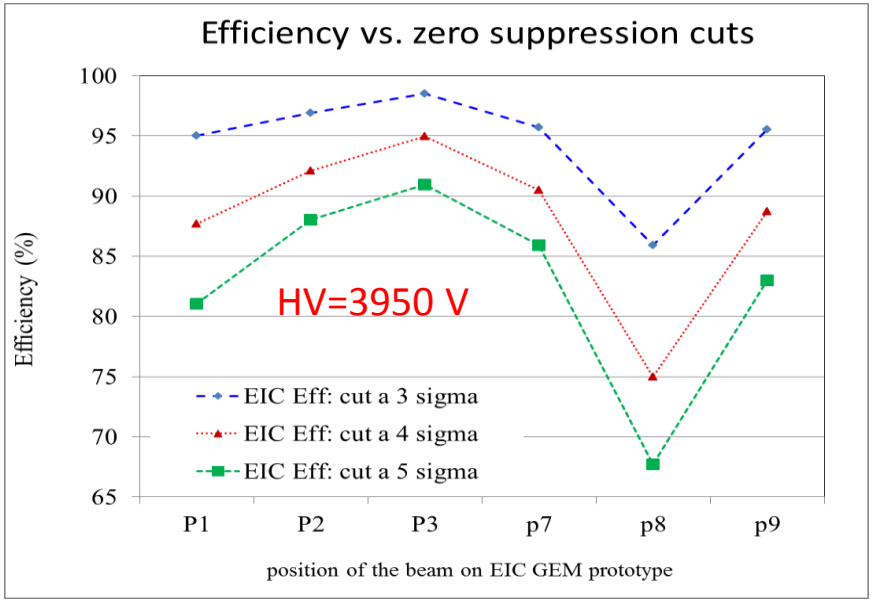
Performances of EIC prototype vs. beam position scan



- Efficiency drop at P8 ➔ beam at the edge of the chamber
- Expected non uniformity of cluster size and charge sharing

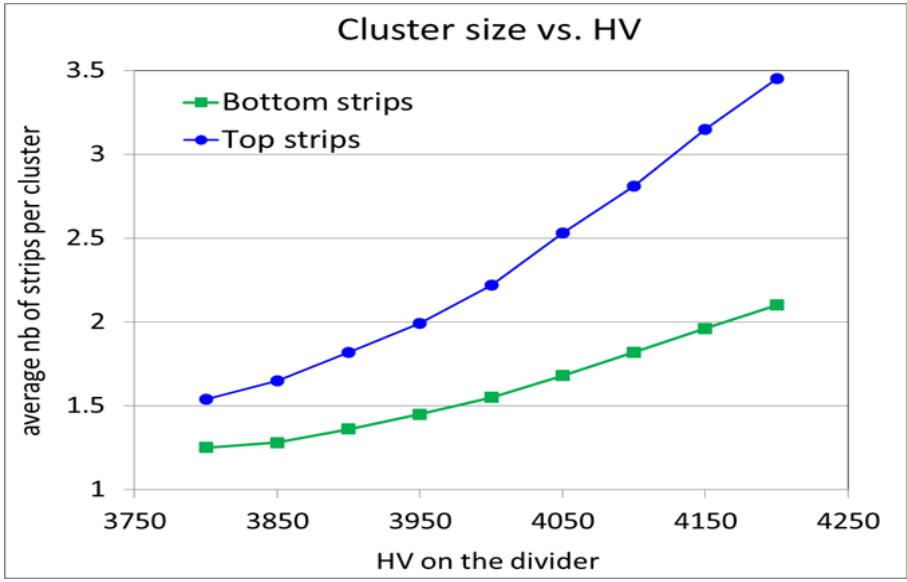


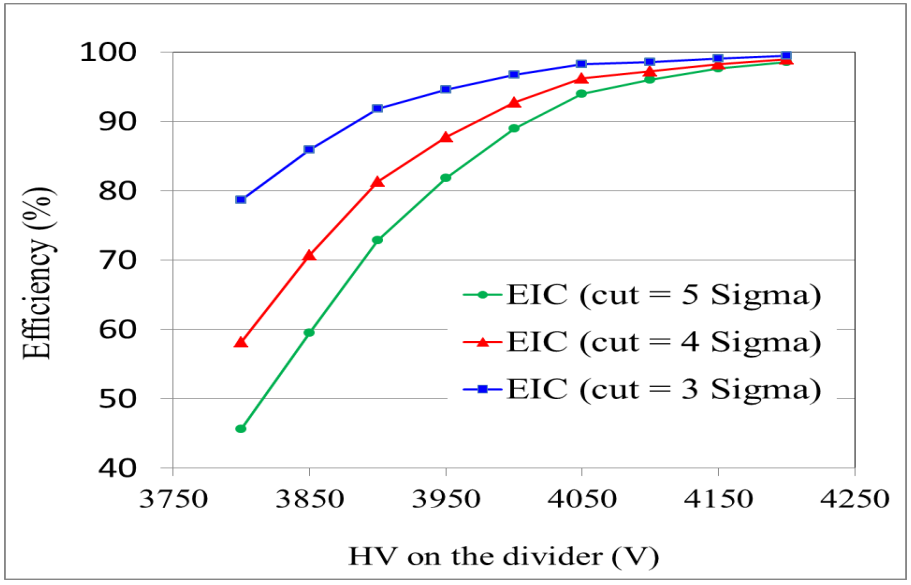


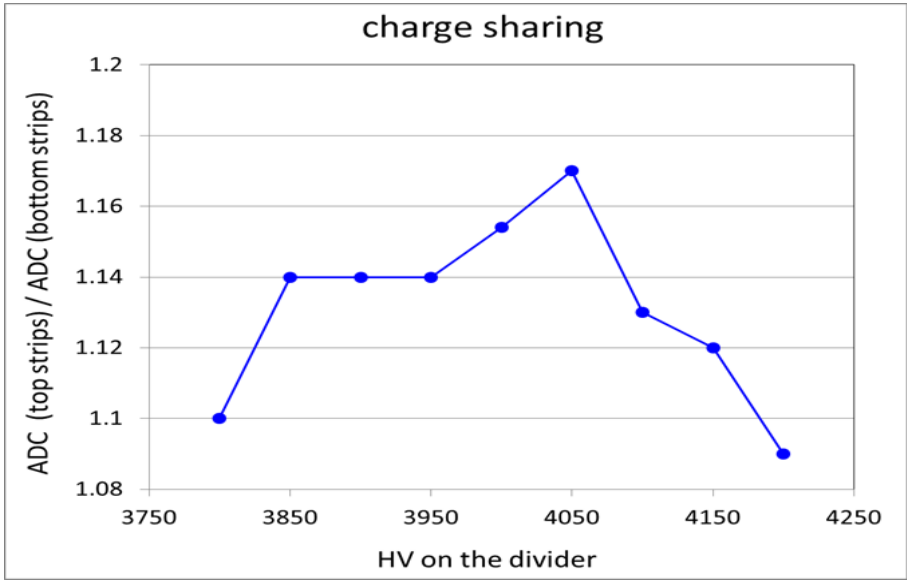


Performances of EIC prototype vs. HV scan (P1)

- 95% efficiency at 4050 V at P1
- Charge sharing independent of the HV
  - Drop at higher value ➔ saturation of apv25 gain (see next slide)
- Limited increase of cluster size increase for the bottom electrode

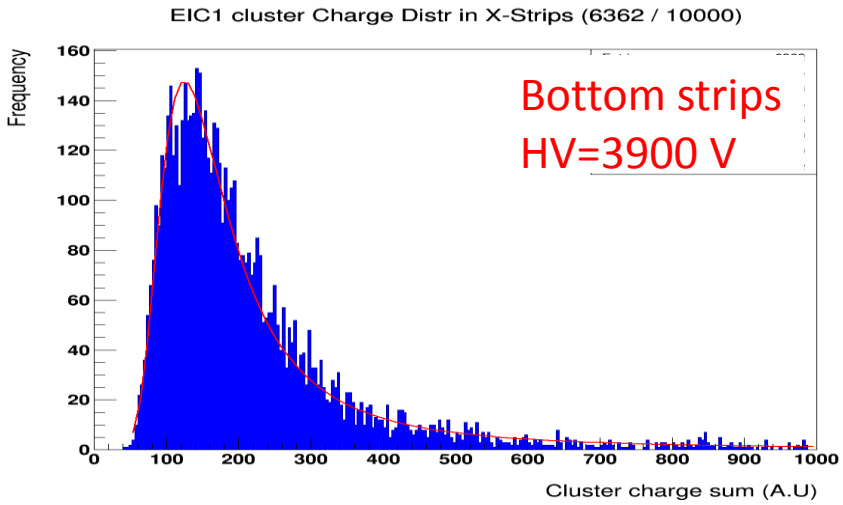


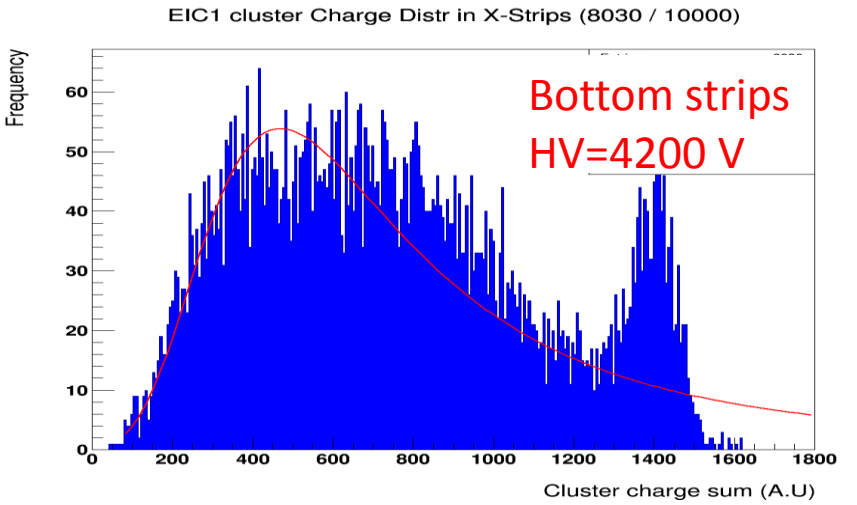


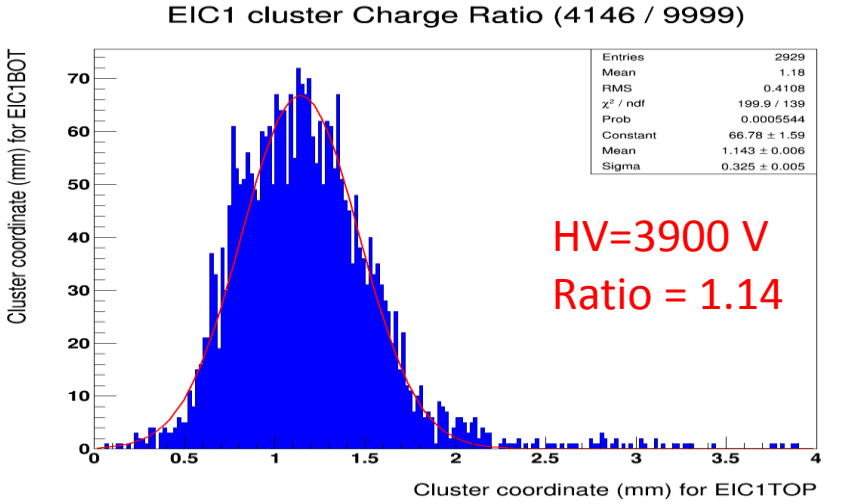


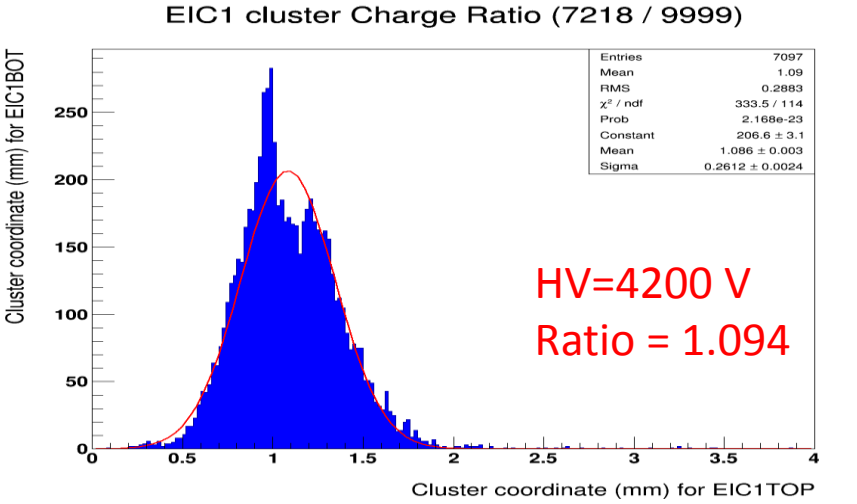
Saturation of APV signal and double pics on charge sharing

- Limited dynamic range of the apv25 ➔ saturation at high voltage
- Need to find right balance between saturation and detector efficiency
- One solution is reduce the width (pitch) of the readout strips ➔ go from 550 μm to 40 μm









Plans for the future

- Next few weeks to come
  - Refine the analysis with the detector angle correction (get clues from Aiwu)
  - Prepare the results for submission of NIMA paper
  - Submit the abstract for IEEE NIM/NSS
- Later
  - Start working on EIC prototype II design
  - Wider frame for the streching of the GEM foils and redesign of the HV sectors
  - New ideas for the readout: Panasonic connectors, and smaller pitch/strips
- EIC prototype II: size of the detector size?
  - Bigger (1.2 to 1.5m): ideal but limitation on the funding
  - Current 1 m long: Reuse the clean room equipment of the first proto ➔ all the expenses will go to the detector design and parts
  - Smaller chamber ➔ just to validate the new ideas if the funding is not enough